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RULES DOCKET
1999 JUL 29 P 12: 19

27 July, 1999

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U.S. DEPARTMENT OF TRANSPORTATION DOCKETS
DOCKET NO, FAA-1999-5041
400 SEVENTH ST. SW.
ROOM PLAZA 401
WASHINGTON, D.C. 20590

FAA-99-5401-39

Subject: Docket No. FAA-1999-5401; Notice No.99-02.

Bombardier Aerospace has reviewed NPRM 99-02, AC 9 I-MA, and AC 120-XX and has the following comments:

1. When the damage tolerance certification requirements were introduced in FAR Part 25.571 by Amendment 25-43, the regulatory authority appeared to have recognized that this approach may not be appropriate for all types of structure. This resulted in the inclusion of a provision that safe-life evaluation was permissible if the applicant established that compliance with the damage-tolerance requirements of the amended rule was impractical. Airplanes certified to Part 25.57 1 tend to be relatively large with structure that is of predominantly fail-safe design which readily lends itself to the damage tolerance approach because the structure was designed to be inspectable. The expectation that most of the structure in this class of airplane would be certifiable to damage-tolerance requirements was reflected in the accompanying advisory circular (AC 25.571-1), which cited landing gears and engine mountings 8s examples of structure that may not be amenable to damage tolerance certification (this was later narrowed down to landing gears only in AC 25.571-1A).

   NPRM 99-02 as currently written fails to recognize that not all structure lends itself to the damage tolerance approach and is therefore more restrictive than the current certification requirement for new designs. The NPRM states that for airplanes certified before modern damage tolerance analysis and inspection techniques were available, the rule would "'prohibit operation of these airplanes after specified deadlines unless damage-tolerance-based inspections and procedures are included in their maintenance or inspection program", The seriousness of this failure to recognize the unsuitability of damage tolerance methods for all structure is accentuated in this instance since the class of airplane affected by the proposed rule is more likely to contain structure that was not designed to be inspectable and for which it was intended that airplane safety would be maintained by timely component replacement. In many airplanes of this class, structure of this nature is not confined just to landing gears, but may exist in much of the primary load bearing parts of the airframe. Insistence on inspection of such structure creates the risk of accidental damage, which, coupled with the potential unreliability of such difficult to perform inspections, may actually reduce the level of safety below what can be achieved with the safe-life approach.

The de Havilland DHC-6 is a typical example of this class of airplane. The wing on this airplane is supported by a single load path strut connected at the fuselage to a single load path machined carry-through member and at the wing to a single load path machined main spar. It has been established, for example, that the only viable way to detect cracks in this spar before propagation to hazardous size is by fastener removal and the use of special eddy current hole probes. Fastener removal is a very time consuming task that entails a significant risk of hole damage since the fasteners are installed with interference When hole damage occurs and is detected, the holes have to be reamed out and oversize fasteners installed, a process that clearly cannot be repeated too often and may limit the number of inspections that can be performed. If hole damage is not detected, the risk of premature failure could negate any benefits derived from the inspection program. The risks with this procedure are accentuated by the reality that on airplanes of this class, maintenance work will in some instances be performed by facilities of a lower caliber than those available to major operators, which calls into question the reliability of what are quite demanding inspections. The difficulty here is not with the analytical fracture mechanics portion of the damage tolerance approach, since sufficiently accurate methods now exist for crack propagation life and residual strength determination; rather, a problem arises because of the risks associated with the implementation of the inspection requirements that flow from such analysis.

The DHC-6 Series 300 was originally certified with a 66,000 hour safe-life with a one time wing replacement mandated at 33,000 hours. Because of the considerations outlined above, Bombardier (de Havilland) and Transport Canada concluded, during an aging airplane review undertaken in 1996, that continued operation of this airplane type under the originally certified safe-life provisions, augmented by damage tolerance based inspection of those parts of the structure where this was practicable, was the most appropriate course of action for ensuring that the certification level of safety of these airplanes is preserved. This action is supported by 33 years of operational experience with this airplane type, a period during which a significant number of wings reached their 33,000 hour replacement time without the occurrence of a single structural failure.

As a result of the above noted aging airplane review Transport Canada issued Airworthiness Directive CF-96-15 against all Models of the the DHC-6 Twin Otter on September 17, 1996, requiring these additional actions to ensure continued structural integrity. We note that the FAA has not mandated this program and request that the FAA does so as a part of this new aging airplane safety initiative.

2. AC 91 -MA, APPENDIX 1, Para 5 requires that an upper boundary for the continuing structural inspection program must be set by the analyst and approved by the FAA. Presumably the intent of this upper limit is to avoid failures due to MED/MSD. However, for single toad path structure, MED/MSD is not considered to be an issue (since there is only one load path, there can be no MED; also the absence of feature replication means that multiple small crack coalescence into one large crack is not physically possible, so there can be no MSD). It could therefore be argued that under the provisions of the proposed rule such structure can continue in service indefinitely, since, without the possibility of multiple crack interaction, there can only be one dominant crack which should be just as detectable during the latter part of the components life as was the case during the early stages. This would place sole reliance for continued safe operation on inspection. a situation that is likely to create increasing risk as the structure ages and in cases where the inspection is difficult to perform, is of doubtful reliability and creates the possibility of damage to the structure. The ensuing risk is likely to be significantly higher than that associated with use of the safe-life option.

3. In view of the above considerations, the FAA is strongly urged to amend NPRM 99-02 and AC 91 -MA to permit the safe-life option for airplanes where,

a) the structure is such that inspection requirements stemming from damage tolerance analysis result in inspection tasks which cannot detect cracks with an acceptable level of confidence and/or are likely to result in structural damage that could negate any benefit derived from the inspections i.e. single and multi load path structures which were not designed to be inspectable.

and

b) fatigue life has been established in a manner acceptable to the FAA. In our view one acceptable way of establishing fatigue life would be by a component fatigue test of at least the most critical portion of the structure.

Note: Although the example of the DHC-6 discussed above happens to involve single load path structure, similar difficulties and risks can arise with multi load path structure that was not designed to be inspectable. Use of the safe-life option should not therefore be dictated by whether the structure is single or multi toad path, but should instead be based only on the viability of the damage tolerance approach.

4. Page 163 11, column 1, paragraph 1 of the NPRM states that "the rule does not increase intended safety; instead it maintains the level of safety established at the time each model's type design was approved by the FM'. The following observation can be made with respect to this statement. It is recognized that the safety level of a structural component can be expected to decline as the structure ages. Therefore, for components for which neither a safe-life nor an adequate inspection program has been established, post-certification action may be needed to maintain an acceptable safety level as the aircraft ages. However, this is not the case for a safe-life certified component. The act of establishing a safe-life at certification amounts, in fact, to a choice of acceptable safety

level since safety level is a direct function of safe-life magnitude. Therefore, safety level cannot fall below the level accepted at certification since the component will be withdrawn from service before this occurs. Continued reliance on safe-lives determined at type certification as a means of addressing continuing airworthiness concerns (as recommended in item 3. above) is therefore not contrary to the FAA's objective, as stated in the above NPRM quote,

5. Under the beading "De Havilland DHC-6 (all models)", the NPRM correctly states that a "Canadian AD, issued in September 1996, mandates the retirement of the airplane at 66,000 hours", However, in Appendix N to PART 121, Appendix B to PART 129 and Appendix G to PART 135, the design life goal for the DHC-6 is incorrectly shown as 33,000 hours when it should be 66,000 hours

In summary, retirement times for the DHC-6 are:

	RETIREMENT TIME	
SERIES	HOURS **	FLIGHTS **
100/200/300	66,000	132,000

** whichever comes sooner

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